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angle. For the observation of weak magnetic fields in regions remote from sun-spots a compound quarter-wave plate, consisting of strips two millimeters in width, set so that the principal sections of adjoining strips make an angle of 90° with one another, is employed. For other investigations, especially of sun-spot spectra, a circular quarter-wave plate, divided through the center and consisting of two parts whose principal sections are at right angles, is used. For the study of plane polarization phenomena, half-wave plates, similarly divided into two parts, are also supplied.

As the position angle at which these various plates must be set depends not merely upon the Sun's declination and the hour of the day, but also upon the position angle of the spectrograph slit, it is desirable that the polarizing apparatus be so arranged that it can be tested in conjunction with the polarimeter, set for the proper declination and hour angle of the Sun. In this way all of the adjustments of the polarizing apparatus can be made and tested in advance or, in case it is desired to determine exactly what the polarization phenomena were at the date of some given observation, these can be reproduced and observed. The entire apparatus, including the polarimeter, can also be set up in conjunction with the 75-foot spectrograph, for the study of the polarizing effect of the grating. GEORGE E. HALE.

THE MAGNITUDE EQUATION AND ZENITH CORRECTION IN MERIDIAN CIRCLE OBSERVATIONS.—The determination of the above corrections has recently been repeated with the Repsold meridian circle of the Lick Observatory. Following the fifteen years of observing with this instrument, two years' work was done with the Pistor & Martin's 8-inch meridian circle of the Dudley Observatory, used for the San Luis Observatory of the Carnegie Institution. Some change in personal equation might be expected, with the use of another instrument, under conditions of observing that were different in many particulars. The values determined, both before and after the observations at San Luis, are tabulated here, for comparison with the approximate values which have been taken out for the southern observatory.

The summation of the magnitude equations had been published in *Astronomische Nachrichten*, 4184, up to the year 1907. The summation of the (N-S) correction, up to the year 1898, appears in Volume VI of *Lick Observatory Publications*; and the value derived during fundamental work here, in the years 1905 and 1906, has been included. In both corrections, the two observations of one star are here counted as one determination of the value.

MAGNITUDE EQUATION.

Lick Observatory—

	Date	No.	Mag. Eq.
South stars	1896	75	—0 ^s .009
“ “	1898	60	—0 .006
“ “	1902	48	—0 .006
“ “	1907	49	—0 .010
Sum 232			Mean —0 ^s .008
North stars	1907	91	—0 ^s .025
South stars	1911.9	45	—0 .010
North stars	1911.9	50	—0 .016

San Luis Observatory—

South stars	1909-1910	100	—0 ^s .010
North stars	1909-1910	300	—0 .011

The whole number of determinations at San Luis will be in excess of the above figures, and the final computations may give a value very slightly different from the one tabulated above. It is based upon a screen value of 3.9 magnitudes, derived from observations made specially for the purpose at San Luis. It will be recalled that the clock stars, and fast-moving stars in general, were north of the San Luis zenith, while of course the contrary conditions prevail here. In combination with the recent determinations here, which were distributed among eight nights, nearly as many stars, selected from the fainter stars of the Harvard Photometry, were observed, to give by comparison the reduction in magnitude due to the screen. These stars were observed exactly as were the bright stars, the magnitudes of which were also taken from the same photometry. The screen used is commonly in service as the cap cover of one of the collimators, which have objectives of the same size as the telescope of the meridian circle, and the screen value derived

in the 1911 series is 4.7 magnitudes. In general, the visual estimates made here appear to be 0.2 magnitude brighter than the photometric scale, mostly due to the differences in estimate for the faintest stars of the list. The photometric scale appears to be about the same amount fainter than the usual visual scale, for a large proportion of the bright stars used; so that the screen value would be nearly identical from either source, visual or photometric scale.

In connection with the San Luis determination, it might be noted that the above magnitude equation was very near the mean equation of the five telescope observers, one of whom had an equation of the contrary sign. The largest equation of all, curiously enough, was found for the observer who had previously shown no equation of appreciable amount in observing with the same instrument and apparatus, at the Dudley Observatory in Albany.

ZENITH CORRECTIONS.

Lick Observatory.

Date	No.	$\Delta\alpha$ (N-S)	No.	$\frac{1}{2}$ Z.
1894-98	78	+ 0 ^s .029	112	— 0 ^{''} .06
1905-06	66	+ 0 .035	66	— 0 .18
1911.9	120	+ 0 .005	120	— 0 .01

San Luis Observatory.

Date	No.	$\Delta\alpha$ (N-S)
1909-10	210	— 0 ^s .010

The San Luis determination was derived from special observations of zenith stars, distributed among six series, on twelve nights. The 1911 value, determined here, included five series, on ten nights. Both these determinations were made principally by the use of the fainter stars, about seventh magnitude; while most of the early work here, for this purpose, included observations of bright stars only. The sign of the transit correction appears to have changed in the San Luis observations; in both cases, as tabulated above, it would be a correction to be applied to transits south of the zenith. The zenith correction tabulated above is applicable to observed zenith distances, hence would have a sign contrary to that of the refraction correction. The fundamental work of 1905 and

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1906 appears to give an unusually large correction. Those observations were made, in part, during the daytime. The (N-S) quoted above was the smallest in amount of the five observers at San Luis, some eighteen hundred observations having been made for the determination of the corrections of the various observers. The corrections to observed zenith distances have not yet been derived for the San Luis observations.

R. H. TUCKER.